Global innovation index and its impact on GDP of BRICS nations- innovation linkages with economic growth: An Empirical Study

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ABSTRACT

Innovation is an important but challenging factor in creating and sustaining competitive advantage. In 2001, Goldman Sachs coined the term BRICs to describe the four large developing countries of Brazil, Russia, India, and China. The GII (Global Innovation Index) helps to build an environment in which innovation factors are evaluated incessantly, and it provides a key tool for refining innovation policies. The research work Undertaken is phenomenological in nature which attempts to explore the nostalgic and current trends in technological innovations in BRICS through our inductive approach and arrives at conclusion. Most of the information in the research work is from the secondary sources including books, journals, and accessible report data from foreign governmental or agential official websites. The paper embraces sensibly interconnected parts. In the first section of the paper, different Theoretical bases are analyzed to construct our own supposition. The second part discuss how BRICS is handling technological innovations to build innovation determined economy, while the third part explores the interrelationships between GDP and GII on its path to further ensue towards the proposed target. The final part deals with summary and conclusions.

KEYWORDS

BRICS	GDP
innovation	Technological
GII	R&D

INTRODUCTION

Throughout history, societies have leaded an extended path to attain economic development for the victorious ones and still extremely exigent for the laggards. If we take a moment of reflection upon the history of economic development of current modern human societies, we can establish that the process of industrialization and innovation has always been the key push in the creation of today's giant and powerful economies of Europe, the USA, Japan and many others. There has been an increased awareness and gratitude of innovation in the last two decades as a means to create and preserve sustainable competitive gain and as a key element of business triumph. The conventional resource based view asserts that competitive advantage rested on fundamental core values like innovations, quality, cost and timeliness Conversely, due to increasing global competitiveness and technological advances, innovation has become an imperative supplementary factor in creating and nourishing competitive advantage in a hastily changing business environment (Johannessen et al., 2001; Lee, 2009). Regrettably, managing the dicey and intricate process of innovation has been challenging (Hollins, 2000; Bueno et al., 2008) and not always managed well. Zaltman et al (1973). A variety of factors and approaches are used by different authors to measure innovation at different levels, such as the firm or the country level. Garcia and Calantone (2002) reveal that the terms "drastic, incremental, really-new, clichéd, sporadic, architectural, modular, recuperating, and evolutionary" have been used to define innovation. Johannessen et al. (2001) has suggests that the picture that emerges from these varied approaches underscores the point that a huge number of factors are interacting to tempt innovation in economic life". Lee (2009) concludes that while each factor remains vital, it is dubious by itself or as part of a group to endow with a sustainable competitive advantage".

It is based on the definition provided by Mashelkar and Prahalad (2010) that "An innovation is the implementation of a novel or considerably improved product, innovative process, innovative marketing method, or a new-fangled organizational system in business practices, workplace organization, or peripheral relations". The given definition forms the root of the Global Innovation Index (GII) developed by INSEAD in 2007.

THE GLOBAL INNOVATION INDEX (GII)

The Global Innovation Index by INSEAD is an international business school is a yearly publication of INSEAD which features the (GII), a combination of indicators that ranks countries/economies in terms of their enabling atmosphere to innovation and their innovation outputs. In 2012, its 5th edition was published by INSEAD and the World Intellectual Property Organization (WIPO) which is a specialized agency of the United Nations. This Index recognizes the role of innovation in augmenting the economic growth and opulence and acknowledges the calls for a parallel path of innovation which is pertinent to both developed and underdeveloped economies enclosing the indicators that go beyond the conventional measures of innovation like the research and development in a country. This Index has evolved into a precious benchmarking tool to smooth the process of public-private dialogue and policymakers, business leaders and other stakeholders can appraise growth on a recurrent basis. Alcatel-Lucent, Booz and Company and the Confederation of Indian Industry (CII) are the Knowledge Partners. These Knowledge Partners trust in the role of innovation in escalating the competitiveness of nations, enabling economic growth, driving societal changes and structuring the foundation of a country's future. They are dedicated towards producing a precious and non-partisan resource and also provide input to the research underlying the GII, contribute critical chapters to the GII Report and also support the propagation of results.INSEAD began its expedition to find enhanced ways to assess innovation in 2007.In 2011, WIPO united with INSEAD as a Knowledge Partners and at present it a co-publisher of Global Innovation Index. The 2012 edition places greater prominence on measuring economies' ecological sustainability and online creativeness.

In 2012 edition, 141 countries are ranked on the basis of their innovation capabilities and their output.This Index relies on two sub-indices - the Innovation Input Sub-Index and the Innovation Output Sub-Index, both the sub-index are built around pillars which further is categorised into three sub-pillars and each sub-pillar comprise of individual indicators, in total of 84 indicators. The GII 2012 explores the circumstances in which innovation embellishes and documents which countries are most triumphant in nurturing those conditions. Every year, the GII model is revised in a translucent effect. In GII report, 2012, Brazil, Russia and China were

ranked 58th, 51st and 34th correspondingly and India is positioned at the 64th position which is two notches below where the country landed last year. In India, the innovation front continues to be deficits in human capital, research, infrastructure, business superiority etc, it comes last among BRICS nations and in knowledge and know-how outputs, it comes ahead of Brazil only. The GII 2012 report remarks that the BRIC countries should invest additional in their innovation capabilities to attain expected potential.

IDENTIFYING BRICS NATIONS

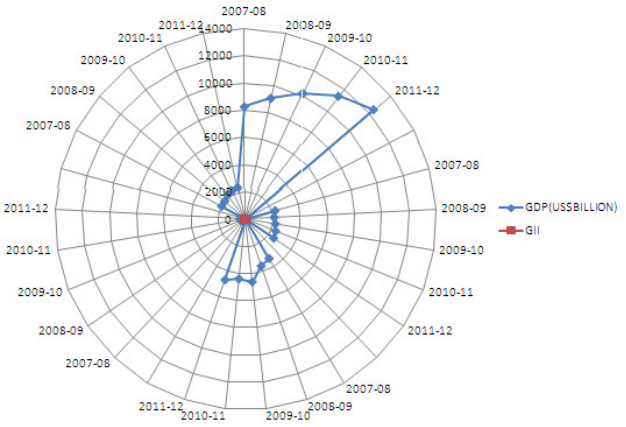
In 2001, the ellipsis BRIC was coined by Goldman Sachs, in a paper titled "Building Better Global Economic BRICs" which stated at the growth projection of the four leading rising economies that are ethnically and geographically incongruent. In 2010, a new acronym BRICS was introduced arising by adding South Africa into the original BRIC grouping and it symbolizes the combined economic power of Brazil, Russia, India, China, and South Africa. The BRICS account for more than 40 % of the global population and almost 30 % of the land mass. As of 2012, the BRICS nations represent approximately 3 billion people, pooled nominal GDP of US$13.7 trillion and an approximate US$4 trillion in combined foreign reserves. At present, the BRICS group is chaired by India. According to Hu Jintao, the President of the People's Republic of China, the BRICS countries are the defenders and promoters of developing countries and strength for world peace. Some analysts have highlighted probable divisions and weaknesses of this group like discrepancy of India and China over territorial issues, the failure to set up a World Bank-analogue development agency, and disputes over UN Security Council reforms between the members. Four economies are among the G-20 top ten, with China, India, Russia, Brazil, and South Africa in 2nd, 4th, 6th, 8th, and 26th place in terms of GDP at PPP respectively. China holds the 2nd position while Brazil, India, Russia, and South Africa hold the 7th, 9th, 11th, and 19th positions, respectively among the G20 members as per the criterion of GDP at market prices see

TABLE 1: GDP AND GII OF BRICS NATIONS FROM 2007-2012

YEAR	*GDP(US$BILLION)*	*GII*
	CHINA	
2007-08	8218.96	3.97
2008-09	9057.38	3.59
2009-10	10128.39	4.83
2010-11	11299.78	5.88
2011-12	12382.55	4.54
	RUSSIA	
2007-08	2276.47	2.6
2008-09	2118.14	2.93
2009-10	2237.4	3.03
2010-11	2383.31	3.58
2011-12	2511.7	3.79
	INDIA	
2007-08	3382.91	3.57
2008-09	3644.53	3.44
2009-10	4651.35	3.1
2010-11	4420.56	3.45
2011-12	4710.8	3.57
	SOUTH AFRICA	
2007-08	286.16	2.87
2008-09	275.27	3.41
2009-10	282.75	3.24
2010-11	363.7	3.52
2011-12	408.23	3.74
	BRAZIL	
2007-08	1996.28	2.84
2008-09	2001.6	3.25
2009-10	2186.53	2.97
2010-11	2294.17	3.77
2011-12	2365.87	3.66

Source: INSEAD Report

FIGURE1: GII AND GDP OF BRICS NATIONS



ECONOMIC GROWTH AND INTERNATIONAL INNOVATION INITIATIVES LINKAGES AND SPILL OVER

Several studies state innovation to be of pivotal importance in the feasibility and opulence of economies given the ever-increasing challenges of globalization and worldwide competition. Centre for Process Excellence and Innovation (CPEI, 2012) defines competitiveness as two capabilities: to innovate and develop cutting-edge technologies and products, and to install and to enhance the operational processes to manufacture and distribute these goods and services to the purchaser. Improvements in economic growth and the quality of life are supposed to be facilitated by invigorating and escalating technological innovation.CII (Confederation of Indian Industry) state innovation to be the only way for Indian industry to have sustainable and inclusive growth. Innovations are seen as the critical factor for job creation, growth and sustainable wealth generation in business firms and in the country as a whole (Goran, 2009).Technological capabilities, technology assimilation and dissemination are regarded to be the backbones of industrialization and international competitiveness without which it can be strenuous to build innovative economy (Dani, 2006).National Innovation System was first introduced by Freeman (1987) which implies energetic collaboration among industries, government institutions and universities whose interface results in overall augment in learning competence and innovative performance of the nation accordingly. Linsu (2000) remarks high rates of investments in physical and human capital to hoist modern planners, managers and engineers out of inexpert imitators of the 1960s. According to Technology Alliance Group (TA, 2012) to sustain a vivacious innovation economy, economies should aid an exceptional education system, sturdy research capacity and a vigorous entrepreneurial environment. (Richard, 2005) states that innovation remains knotty without a significant mass of financiers, entrepreneurs, and scientists, frequently nourished by world-class universities and elastic corporations. Establishment of Ministry of Science and Technology (MOST), Chinese Academy of Science (CAS) and National Natural Science Foundation of China and launch of different national programs like The Key Technologies R&D Program, 863 Program, 973 Program, The Spark Program and Torch Program and many other S&T oriented programs specify how China is desiring its Science and Technology capacity to raise. China's science and technology power is underpinned by the system of 5400 national governmental institutions, 3400 university-affiliated research institutions, 13000 research institutions under large state enterprises, and 41000 nongovernmental research-oriented enterprises. Over the last 30 years we can see manifest augment in scientific power of the nation: 293066 pieces of Chinese resident patent applications submitted to the World Intellectual Property offices around the world positioned China in the top position in the world in 2010.China's 15-year Plan of being innovation-oriented country until 2020 outlines numerous correlated policies including increasing GDP share up to 2.5 % into R&D sphere by 2020, raising the input of technological progress in economic growth to more than 60 %, restraining dependence on imported technology to no more than 30 percent of value added, becoming a top country in terms of invention patents and scientific papers citation gained by Chinese citizens (Denis,2007).India Innovation Initiative – i3, 2012 was communally promoted by Agilent Technologies, Department of Science and Technology (DST), Government of India(GOI) and Confederation of Indian Industry (CII) which aims to protract Innovation Ecosystem in the country by sensitizing, cheering and gratifying innovators and by facilitating commercialization.

India has emerged as an effervescent and resurgent economy in the recent years with ample capital formation, young and large human resource base, hastily escalating and vigorous infrastructure, fortunate information technology base, high GDP growth rates, rising and mounting domestic demand and a cosmic system of public funded R&D institutions. In spite of such a productive and favourable environment, the country has not been able to control its latent and potency towards technology and innovation driven sustainable growth path like other economies in the world. Israel spends more than 4% of GDP in Research & Development (R&D), Japan, South Korea; Scandinavian countries spend more than 3%. US, France, Germany spend more than 2%; China spends more than 1.50%. In India sum spending in R&D is around 1%, Government's spending is 2 to 3 times more than that of Industry's. In the 12th Five Year Plan, Government has rest a goal to twofold India's Gross Expenditure in R&D from its current level of 1% of GDP. Thus at the end of 2016-17, Government will elevate its own investment to 1% of GDP and will take adequate thought-provoking measures to raise private sector's investment to 1% of GDP. In order to rouse private sector's investment in R&D in 2007-8, an innovative pilot project named Global Innovation & Technology Alliance (GITA) was initiated by CII and the Department of Science & Technology (DST), Government of India.DST under its bilateral & multilateral Science & Technology Cooperation agreements with several countries launched industrial R&D programmes with Canada and Israel. In 2011, GITA has been institutionalized as a lawful entity and was incorporated as a private limited company under Section 25 of the Companies Act 1956 promoted together by CII and Technology development Board (TDB) of Department of Science & Technology, Government of India. CII and TDB hold 51% and 49% equity correspondingly in GITA. Its main objectives are to reinforce India's innovation ecosystem through supporting and enabling technology and innovation driven enterprises and to be an efficient institutional mechanism for providing end to end services and support for the materialization of an innovation ecosystem with demand pull for industrial innovation and technology start-ups. In November,2012,The National innovation council, chaired by Dr Sam Pitroda along with the World Bank organized a *Global Innovation Roundtable in which* the global innovation experts from 15 governments gave brainstorming session on the role of innovation in accelerating growth, development and welfare.China is the world's most outstanding emerging R&D hub, lifting its share of global R&D expenditures from 2007 to 2012 to reach about 14% of total worldwide R&D spending. China and India significantly boosted their share of global R&D spending, they doubled their spending from USD 100 to 200 billion (China) and USD 21 to 40 billion (India) from 2007 to 2012.Both the countries now account for almost 20% of global R&D spending. Movimento Brasil Competitivo (MBC) and the Brazilian Agency for Industrial Development (ABDI) punctuated the first-ever US-Brazil Innovation Summit in 2007, chaired by Robert W. Lane, Deere & Company – the Council on Competitiveness organized in 2008 and 2009 a series of 10 US-Brazil Innovation Learning Laboratories across both countries. The US-Brazil Innovation Laboratories have mapped the innovation ecosystems of the United States and Brazil, recognized key barriers and opportunities for change and collaboration and intended a policy strategy that will construct the competitiveness potential of both economies, as well as the Western Hemisphere. South Africa's untapped brains and knowledge network of expatriate assets will soon be activated resulting in increased competitiveness of the country for better realization of return on innovation and entrepreneurship. The SABLE (South African business link to experts) Accelerator was developed by three Global South Africans from Silicon Valley and London which features a core consulting team of influential South African expatriates holding senior positions at international technology(IT), life science and Agri-business companies, consulting firms as well as research and academic institutions, which is dedicated to help South African corporates, academic institutions and companies to commercialize technology innovations, to promote and protect intellectual property, funding of new business concepts and expansion into global markets. It will enable the "Innovators" from South Africa to register and post information about their intellectual property or new business models at the SableNetwork.com web site. This will result in links to Experts and sources of funding and business development support globally.India Innovation Initiatives helps India in becoming a leader in global innovation ranging from India's broader economic and institutional system with a precedence on promoting stronger competition among enterprises to give a free leash to innovation and tap innovative business ideas in India, to more specific areas like research and development (R&D) and intellectual property rights (IPR), foreign investment and technology transfer, grassroots innovation, testing,

quality services, education and skills, telecommunications infrastructure, high-speed research networks, and early-stage technology development. This initiative is principally driven by the development of science and technology and R&D. Innovation and competitiveness have a vibrant, reciprocated relationship, innovation thrives in a competitive environment and plays a key role in the accomplishment of such an environment. It generates fiscal value, new jobs in the economy and cultures of entrepreneurship and also promotes economic growth leading to inclusive growth. Considering BRICS nation's potential to innovate, the finest performance has not yet been achieved.

To achieve the objective of the paper, it is divided into following sections; Section I gives the insight of importance of innovations and economic growth with deep explanation of GDP and GII along with international innovation initiatives by the BRICS nations. Section II gives detailed Review of Literature, Data and Methodology is explained in Section III followed by Analysis and interpretations of results in section IV. Summary, conclusions and recommendations forms the part of section V and references are contained in the last section.

SECTION II: REVIEW OF LITERATURE

The following section gives deep insights of studies undertaken in India and abroad. Economists have been paying attention in the role of innovation in economic development or growth for a long time. The impact of innovation is treated as part of the Solow residual and therefore a key contributing factor to economic progress and long-term convergence (Solow 1957, Fagerberg 1994). Due to the recognition of endogenous growth theories, economists are increasingly of the view that differences in innovation competence and potential are principally responsible for continual variations in economic performance (Grossman and Helpman 1991). The effects of innovation on economic growth cannot be fully understood without taking into account the social and institutional conditions in an economy. Rodriguez-pose and Crescenzi (2008) state how the interface between research and social-economic and institutional conditions shapes regional innovation capacity. China has become the latest story of economic success and has enjoyed double-digit growth for three decades. China's policy makers are navigating the economy towards an alternative growth model in which knowledge and technology would play the key role due to resource constraints and raising costs. Consequently, innovation is becoming increasingly imperative and robustly promoted in the Chinese economy. It is reflected in numerous indicators. China's Research & Development expenditure as a percentage of GDP has unadulterated from 0.71% in 1990 to 1.52% in 2008 which is expected to reach 2.5% in 2020 (Schaaper 2009). The gap between China and the world's advanced economies in terms of R&D spending would be abridged considerably by then, as the latter usually spend about 2- 3% of their GDP on R&D. In China, the figure of domestic patents applied and granted grew from 69,535 and 41,881 items in 1995 to 586,498 and 301,632 items in 2007.The number of Chinese applications for patent registration also amplified from 13,510 to 107,419 with the number of granted patents rising from 3,183 to 50,150 during the same period. Between 1995 and 2006, the number of publications by Chinese scientists and engineers also increased from 7,980 to 71,184 according to the science citation index. The mounting role of innovation in China has fascinated the concentration of scholars both inside and outside the country. Wei and Liu (2006) reveal the optimistic impacts of R&D activities on productivity performance at the firm level and their finding is consistent with observations at the sector level by Wu (2006, 2009) who state that R&D contribution to productivity growth is statistically significant in manufacturing. Few authors also provide substantiation using cross-regional data (Kuo and Yang, 2008). Others mainly focused on firms within particular region (Hu and Jefferson 2004). Education has been a predominantly vital driver in the expansion of the capacity for technological innovation, as the experience of Finland, Korea, Taiwan, and Israel clearly shows. (Lopez-Claros, 2006).The above studies clearly identifies the importance of GDP and GII .The following paper gives the empirical relationship of GDP and GII in BRICS. China and Russia both try to prop up innovation growth through the support of state-owned enterprises. They seem to suppose that with the underdeveloped private sector, public companies are the only ones that have sufficient innovation capabilities and finance to take jeopardy in promoting S&T growth today. It is generally acknowledged that state-owned enterprises are quite incompetent in delivering concrete results with low levels of productivity and mounting corruption (Breznitz and Murphree, 2011; Klochikhin, 2012b).Both the countries have been developing a market-oriented patent system since mid-1980s when the foremost evolution took off. Today, China

has surpassed the United States in the number of patent applications even though the quality is still measured suspicious. Chinese assignees applied for 229,096 patents in 2009 as contrasting to the US 224,912 patent applications (Shapira and Wang, 2010; World Bank, 2012).

SECTION III: DATA AND METHODOLOGY

The data used in this study is secondary mainly taken from INSEAD Reports, publications, special reports and surveys, Government of India and many sources of RBI from the handbook of Indian economy. The period of study is from 2007-2012. Given the nature of the problem and the quantum of data, we first study the data properties from an econometric perspective starting with the stationarity of data. We employ cointegration technique to understand the causality in GDP and GII (Global Innovation Index). The time series stationarity of sample price series has been tested using Augmented Dickey Fuller (ADF) 1981. The ADF test uses the existence of a unit root as the null hypothesis. To double check the robustness of the results, Phillips and Perron (1988) test of stationarity has also been performed for the sample series. Descriptive of the data will be analysed to understand the nature of the data. Then VAR model will be employed which is a statistical model used to confine the linear interdependencies among the time series. VAR models generalize the univariate AUTO-REGRESSION models. All the variables in a VAR are treated symmetrically; every variable has an equation illuminating its fruition based on its own lags and the lags of all the other variables in the model. VAR modelling does not necessitate professional knowledge formerly used in structural models with concurrently equations. When specifying a VAR, one first has to decide which variables to include into the model. Since one cannot include all variables of potential interest, one has to refer to economic theory for any priori ideas when choosing variables. This involves some process of marginalization, in that the joint probability density of the VAR model must be interpreted as having been marginalized with respect to some variables that are potentially relevant (see e.g. Clements and Mizon 1991, or the discussion in Canova, 1995).Having specified the model, the appropriate lag length of the VAR model has to be decided. In deciding the number of lags, it has been common to use a statistical method, like the Akaike information criteria. Alternatively, one can choose a rather large lag length a priori, and thereafter check that the results are independent of this assumption (this is the approach taken in Blanchard and Quah 1989). However, a large lag length relatively to the number of observations, will typically lead to poor and inefficient estimates of the parameters. On the other hand, a too short lag length will induce spurious significance of the parameters, as unexplained information is left in the disturbance term. Forecasts from VAR models are quite flexible because they can be made conditional on the potential future paths of specified variables in the model. In addition to data description and forecasting, the VAR model is also used for structural inference and policy analysis. In structural analysis, certain assumptions about the causal structure of the data under investigation are imposed, and the resulting causal impacts of unexpected shocks or innovations to specified variables on the variables in the model are summarized. These causal impacts are usually summarized with impulse response functions and forecast error variance decompositions.

The stationary Auto regression Model

Let Yt = (y1t, y2t,. . . , ynt) denote an (n×1) vector of time series variables. The basic p-lag vector autoregressive (VAR (p)) model has the form

Yt= c + Π1Yt–1+Π2Yt–2+ · · · + Πp Yt–p + εt, t = 1, . . . , T (11.1)

Where Πi are (n× n) coefficient matrices and εt is an (n × 1) unobservable zero mean white noise vector process (serially uncorrelated or independent) with time invariant covariance matrix Σ. For example, a bivariate VAR (2)

Once we have established the long run relationship between the variables of the VAR model, the next logical step for our purpose is to examine the Granger-causal relationship among the variables. X is said to “Granger-cause” Y only if the forecast of Y is improved by using the past values of X together with the past values of Y, than by not doing so (Granger 1969). Granger causality distinguishes between unidirectional and bi-directional causality. Unidirectional causality is said to exist from X to Y if X causes Y but Y does not cause X. If neither of them causes the other, then the two time series are statistically independent. If each of the variables causes the other, then a mutual feedback is said to exist between the variables. In order to test for Granger causality, we will estimate variable VAR model as follows, where all variables are initially considered symmetrically and endogenously. Then we have adopted the VAR Granger Causality/Block

Exogeneity Wald Tests to examine the causal relationship among the variables. An endogenous variable can be treated as exogenous under this system. The chi-square (Wald) statistics is used to test the combined significance of each of the other lagged endogenous variables in every equation of the model and as well as for joint significance of all other lagged endogenous variables in every equation of the model.

SECTION IV: ANALYSIS AND INTERPRETATION OF RESULTS

The following section gives the results and its interpretations relating to testing the relationship between GDP and GII in BRICS.

I) To begin the study the first step is to test the stationarity of data using ADF test first on actual data then on return series see Table 2.

TABLE 2: RESULTS OF STATIONARITY OF DATA

NAME	Panel-A		Panel-B	
	(ADF) Test	Phillips-Perron Test	(ADF) Test	Phillips-Perron Test
	T-Statistics	T-Statistics	T-Statistics**	T-Satistics**
GDP	-1.09	-0.51	-41.98 **	-41.98 **
GII	1.12	-1.38	-41.35 **	-41.32 **

Stationarity test of the variables used in the study, i.e. GDP and GII

II) After testing the stationarity of data the next step is to find the co-integration between the variables as variables were found to be non stationary which is a precondition to apply this test see table III.

TABLE III: RESULTS OF CO INTEGRATION BETWEEN GDP AND GII

Trend assumption: Linear deterministic trend
Series: GDP GII
Lags interval (in first differences): 1 to 1

Unrestricted Co integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.526485	21.12447	15.49471	0.0064
At most 1 *	0.157081	3.930338	3.841466	0.0474

Trace test indicates 1 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.526485	17.19413	14.26460	0.0167
At most 1 *	0.157081	3.930338	3.841466	0.0474

Max-Eigen value test indicates 2 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The above results as shown in table III confirm the co-integration between GDP and GII as P value is significant at 5 % level of significance.
To find the causality in the two variables we use Granger Causality Test the results of which are exhibited in Table IV.

TABLE IV PAIRWISE GRANGER CAUSALITY TESTS

Null Hypothesis:	F-Statistic	Prob.
GII does not Granger Cause GDP	4.06697	0.0349
GDP does not Granger Cause GII	2.92676	0.0793

The results shown in Table IV confirm bidirectional causality between the two variables i.e. innovations lead to rise in economic growth and with economic growth innovation level rises as P- Value is significant at 5% level of significance.

SECTION V: SUMMARY AND CONCLUSION

The GII project was developed by INSEAD with the aim of determining how to discover metrics and approaches to incarcerate the affluence of innovation in society and go at the forefront of such customary measures of innovation. Innovation is imperative for driving economic progress of BRICS economies. BRICS need to refurbish their innovation drivers to achieve their expected prospective. Since 2008, the BRIC countries (Brazil, the Russian Federation, India, China and South Africa) have been seen as drivers of the global economic engine. But these countries too are slowing down regardless of their unrealized potential; they need to persist to invest in constructing their innovation infrastructures. China and India comes at 1st and 2nd place in the Innovation Efficiency Index rankings, correspondingly, indicating a great capability to decipher pockets of superiority in their innovation infrastructures into precious innovation outputs.

Conversely, both of these countries have weaknesses in their innovation infrastructures like ICT is poor in China and Human capital and research needs enhancement in India that must be addressed if these countries desire to recommence higher levels of growth and innovation. Brazil has suffered the prevalent drop among the BRICs which demonstrates the significance of addressing structural weaknesses in innovation ecosystems in the face of a global slowdown. Many governments are inculcating innovation in their growth strategies. Innovation is no longer constrained to Research & Development laboratories and publishing of scientific papers. Innovation could be further universal and horizontal in nature which includes both social innovations and business model innovations. Recognizing innovation in emerging markets is seen as crucial for inspiring people—particularly the next generation of entrepreneurs and innovators. GII helps in creating an environment in which innovation factors are evaluated persistently and provides a key device and rich database of comprehensive metrics for refining innovation policies. GII is more apprehensive in recuperating the journey for better measurement and understanding of innovation and in identifying embattled policies, superior practices and other levers to encourage innovation.

Results confirm the interrelationship between GDP and GII, as after testing the stationarity of data, co-integration between variables are tested, the results confirm the co-integration and after to test the causality Granger Causality is used which confirm bidirectional causality between the variables. There is a close relationship between per capita income rise, productivity, technology and has magical spill over. Countries should encourage innovative initiatives as this will give boost to rise to GDP. Following are the recommendations to strengthen the cross linkages between GDP and GII:

- To encourage the process of research more and more research institutions should be opened so that innovations can be initiated at the faster level.
- To initiate the faster development of innovations the pro active role should be played by state owned enterprises rather than private players as their main role is social welfare and not having commercial objectives.
- Ample opportunities should be provided to the people in their own territory as a result of which there is a brain gain rather than brain drain.
- More and more SEZs should be developed as because of these the spillover inter-linkages will be further strengthened.
- Domestic research has to be deepened to give us the solution of innovations and sustainability as FDI and knowledge spill over from the developed countries are not enough for innovative aided growth.

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